Argonne Helps Take Spallation Neutron Source from Concept to Reality

ARGONNE NATIONAL LABORATORY

Opportunity

Neutron particle beams provide a powerful tool for studying the structure and dynamics of materials at the atomic, molecular, and macromolecular levels. Although most people do not know it, neutron scattering research has a lot to do with our everyday lives. Airplanes, credit cards, pocket calculators, compact disks, shatter-proof windshields, and satellite weather information — all have been improved by neutron scattering research.

Six U.S. Department of Energy (DOE) laboratories are partners in the design and construction of the Spallation Neutron Source (SNS), a one-of-a-kind facility in Oak Ridge, Tennessee, that will provide the most intense pulsed neutron beams in the world for scientific research and industrial development (Figure 1). Construction of the $1.4 billion facility began in 1999 and is scheduled for completion in 2006.

Argonne's Role

Argonne scientists were selected to help design the SNS because of their applicable experience operating the Intense Pulsed Neutron Source (IPNS) for the past 20 years, operating the CP-5 reactor in the 1970s, participating in studies at other major user facilities worldwide, and conducting neutron scattering studies related to materials science and microscopic dynamics. Argonne developed the entire field using accelerator-driven pulsed spallation sources for neutron scattering, beginning with the ZING prototypes in the 1970s and later with IPNS. Because of their extensive experience, Argonne researchers and technicians will continue to play a vital role not only in the design of the SNS, but in its operation as well.

Argonne is responsible for the Instrument Systems Section of SNS. Operating with a budget of $78 million, Argonne was asked to design, construct, and install five best-in-class neutron scattering instruments for the SNS; develop the infrastructure to enable other groups to design and construct additional instruments; expand the neutron scattering user community; and prepare plans for operation of the SNS instruments.

Progress

Argonne's designs for five neutron scattering instruments have been granted final approval for development at the SNS:

Figure 1. Spallation Neutron Source at ORNL.

- High-resolution inelastic spectrometer. Will measure energy transitions or diffusive motions in any material, from crystal substances to biological molecules, with an unprecedented combination of resolution and range.
- Small-angle neutron scattering instrument. Will allow scientists to observe the shapes and distributions of large molecules or collections of molecules thousands or tens of thousands of angstroms (10^{-8} cm) across. This capability can be used to study a variety of systems, including biological molecules in solutions, colloidal systems, and polymers.
- Magnetism (vertical surface) and liquids (horizontal surface) reflectometers. Will allow researchers to look at thin layers of materials to determine their thickness, roughness, and magnetic or chemical density profiles when subjected to different conditions.
- Powder diffractometer. Will enable scientists to collect more complete data on the structure of crystalline materials — faster, at higher resolution, and with greater angular coverage than ever before.

Argonne has provided technical expertise to groups of university scientists seeking to design and build additional SNS instruments. So far, these groups have secured funding to construct two additional instruments; they have contracted with Argonne to prepare the engineering designs for the instruments. To further promote such endeavors, Argonne has hosted a number of

workshops to explore: how neutron scattering can contribute to different scientific areas and what types of instrumentation are best suited to extracting the desired information. These scientific outreach efforts are expected to continue throughout SNS construction and operation.

In another SNS-related thrust, Argonne researchers are preparing plans to enhance the operation and capabilities of the IPNS in order to educate a larger number of potential SNS users. The near-term expansion of the capabilities at IPNS will enable many more scientists to experience first-hand the power of neutron scattering to provide answers not obtainable by any other research tool.

Benefits

When completed, the SNS will enable a new generation of experimental studies of interest to chemists, physicists, biologists, materials scientists, and engineers, in an ever-increasing range of applications.

Argonne's participation in the SNS design permits the development of instrumentation that will meet Argonne's scientific and programmatic demands, as well as those of the broader user community. That participation also provides a head start in planning for long-term Argonne use of SNS.

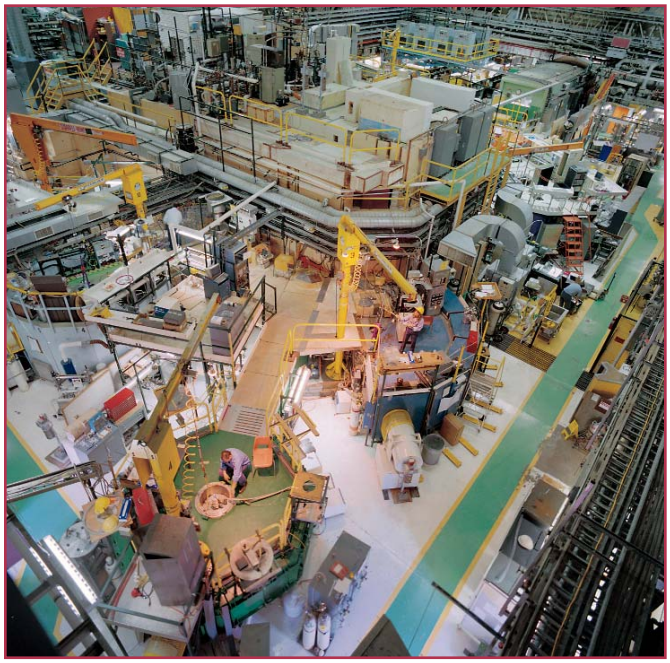

Figure 2. Experiment hall at IPNS, showing operating instruments.

Sponsors

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Partners

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